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OPTIMAL ENFORCEMENT POLICIES UNDER THE THREAT OF COLLUSION AND EXTORTION[1]

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Abstract

We consider a model of enforcement where the Principal relies on the Supervisor for information on the Agents. We argue that optimal policies must consider both collusion and extortion possibilities. Both collusion and extortion can be prevented by mechanisms resembling appeals process. However, if appeals involve a net cost for the agents, then optimal enforcement policy may involve over-enforcement or under-enforcement.

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1. INTRODUCTION

In many agency settings (government –taxpayer, regulator-firm), the principal relies on intermediate agents (supervisors) to obtain agent-related information, which is essential to the implementation of the principal's objective. The fact that the supervisor can collude with the agent and hide or distort relevant information has been recognized in the recent literature on collusion and corruption. However, in much of the work, the distortion is only in one direction[2]. The supervisor takes a bribe (side payment) to submit an agent favourable report. Depending on the nature of the information, it is also possible that the supervisor can submit an agent-unfavourable report. In such a case, bribery might still occur but as a form of extortion[3]. Now the agent will be bribing the supervisor *not to distort the true information,* as opposed to the previous case where the agent bribes the supervisor *to distort the information.*

Extortion is as important as the study of collusion. If by paying a bribe to the inspector, I can avoid penalty for tax evasion then I will be tempted to evade taxes. Similarly, if by being an honest tax payer I might be subject to extortion by the inspector, I will be equally encouraged to evade taxes. Hence, both forms of corruption lead to distortion of incentives.

Prevention of collusion between the supervisor and the agent has received lot of attention. This ranges from design of various incentive schemes (reward/penalty for the supervisor) to organization design (layers of supervision). In many of these cases one can design mechanism which can prevent collusion. However, it is not clear how they affect the extortionary behaviour of the supervisor. Do these schemes, proposed to prevent collusion, help reduce extortion as well or do they encourage extortion? Is it possible to design mechanisms which prevent both forms of corruption? Our objective in this paper is to investigate these questions. We show that there is a basic conflict between these two objectives.

[2] Some authors have discussed the issue of harassment, but detailed investigations of information manipulation in the sense of the current paper are by Polinsky-Shavell (2001) in a general enforcement context and Hindriks et.al. (1999) in a tax evasion context. See Margit et.al.(2000) also.

[3] In the corruption literature the distinction is not always clear. For example the Shliefer-Vishny (93) model or the Bliss-di Tella (96) model can be viewed as models of extortion. These models however do not investigate the agency framework.

Beginning with Tirole's (1986) early work, information is generally taken to be *hard information*. Hard information implies costless verification. This means that whatever information the supervisor obtains about the agent can not reported as something else. It can only be suppressed. Since this is important to the study of collusion and extortion, let us consider this issue in a more specific context. Suppose a supervisor is supposed to report on the level of pollution by a particular firm. The firm faces a penalty which is increasing in the level of pollution. The supervisor (with or without some effort) learns the true level of pollution with probability *strictly less than 1.* So the supervisor learns 'nothing' with positive probability. Collusion can take place when the supervisor learns about the true pollution level. If the information about pollution is hard, then a colluding supervisor can report only 'nothing' instead of the true level[4]. This way, the extent of collusion is limited because the agent is not entirely in the clear, the principal still can hold a prior belief about the agent's pollution level. More importantly, extortion can never take place. Collusion is also prevented if the supervisor observes the true pollution level with certainty.

In many other models of corruption, the informational assumptions are less explicit. In some models, the supervisor learns the true level with certainty but there is collusion and the supervisor reports some level other than the true level. Another leading model in the literature, Mookherjee and Png (1996), considers learning to be costly and hence the probability with which the supervisor learns depends on costly effort by him. But a colluding agent always reports a level of pollution which maximises the combined payoff of the supervisor and the agent. In that case, the information about the level of pollution is 'soft'. Hence extortion can take place[5].

So if we allow for some information to be soft, there is always scope for extortion[6]. It has got another important implication. Now the supervisor need not report

[4] Of course in equilibrium this itself may reveal some information.
[5] Mookherjee and Png (96) do mention this possibility. Mookherjee (97) also considers extortion in an extension of this model.
[6] However, extortion need not be present for other reasons. One such reason is the presence of ex-post participation constraints. Suppose it is the efficiency of the firm which matters. The principal wishes to design suitable contracts for firms with various efficiency levels. In this case, reporting an inefficient firm as efficient would mean the firm will get a smaller transfer and support price. That might mean that the firm refuses to participate in the production process altogether and gets its reservation payoff. In most of

"nothing" in states where he has actually observed nothing. The supervisor can report in excess of the true level depending on the nature of his prior belief. Hence, in addition to elicitation information acquisition also becomes a problem. We would not only like the supervisor to tell the truth but also would like to make sure that the supervisor learns the truth more often[7]. However, we shall assume that the supervisor always learns the true state. This way we avoid issues related to collusion under asymmetric information[8].

We consider a problem of enforcement to see how the optimal enforcement policy is affected by the presence of collusion and extortion. Our objective is to analyse the qualitative nature or rather the structure of the enforcement policy. We consider a situation where there are different levels of the illegal activity leading to different social costs and private benefits. Private benefits also differ across the agents. Many enforcement problems fit this case. Firms could choose different levels of pollution, individuals could use different degrees of tax evasion, drug abuse or different degrees of compliance to many laws. In these situations marginal deterrence becomes a key feature of the enforcement policy. Different agents may be allowed to choose different levels of the activities because their private benefits are different. In this context, we show how corruption might lead to under enforcement or over enforcement. Under enforcement refers to the case where certain acts are made legal even though the social cost exceeds the private benefit. This legalisation of the less harmful act is carried out so that better deterrence can be achieved in case of more harmful acts. The legalisation of certain drugs and the 'overlooking' of small offences are all examples of this. What is novel in our analysis is the fact that the opposite- over enforcement can also be optimal. This means that even if some activity generates net positive benefit for some, it might be optimal to make it illegal.

The plan of the paper is as follows. In section 2, we look at the problem of collusion and extortion in a fairly general setting. We show that it is possible to design mechanisms which are both collusion and extortion proof. These require provision for

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these models, the inefficient firm gets its reservation payoff after its type is revealed. Hence, the inefficient firm has no incentive to pay any bribe and there is no scope for extortion.

[7] It has been shown by Mishra (99) that in such cases one can have different compliance levels as multiple equilibria.

[8] See Laffont and Martimont (97) for a treatment of this and the associated problems of dealing with asymmetric information.

costly verification and we show that a system of appeals can serve the purpose. However, if the regulator is not able to choose transfers in an unconstrained fashion, the mechanisms will make appeals costly. Section 3 presents the basic model of enforcement with (at least) three levels of the activity. The optimal enforcement policy is discussed. Section 4 presents the main results concerning the nature of optimal policy under collusion and extortion. Section 5 concludes.

2.COLLUSION AND EXTORTION

Consider an industry where firms are choosing the level of pollution. Suppose firms can choose between whether to pollute (p) or not (n). Later we shall allow for different levels of pollution. Firms derive some private benefit from the act of pollution (save costs) but there is a social harm associated with this act. An enforcement policy by the regulator will comprise of (1) the extent of deterrence to be achieved and (2) an enforcement mechanism $\{\mu , f\}$, where - μ is the probability of detection (monitoring intensity) and f is fine(s). Social welfare SW = SW(a) – C(μ); where SW(a) is the total benefit to the firms minus the social cost and C(μ) is the cost of monitoring at the rate μ. We assume that all fines are subject to some limited liability constraint. Firms have common wealth W.

With prob. μ the action is detected and fine f is imposed. Let F_p (F_n) denote the expected cost to the firm from choosing pollution (no-pollution). Note that this could be different from the original fines intended by the regulator. Assuming that no-pollution implies zero benefit and zero social cost, firms with benefit b will choose to pollute when $b-\mu\Delta F> 0$, where $\Delta F = F_p-F_n$. Optimal policy will be derived from the maximization of SW and it will imply that ΔF be set at the maximum so that μ can be minimised. We want to see whether an arbitrary $\Delta F \leqslant W$ can be implemented or not.

We shall interpret this as an asymmetric information problem. Firm's choice leads to two states, $\theta = p$ and $\theta = n$. The regulator can not observe these states. The regulator (called principal P) relies on the information supplied by the regulation inspector (Supervisor S). A firm is inspected with probability μ and if inspected, S can identify whether the firm has polluted $(\theta = p)$ or not $(\theta = n)$. Hence information acquisition by S is not a problem. But S can manipulate the information. The supervisor S makes a report m_s to the principal about the true state θ. We allow for the possibility that information is not always hard. So S can send a false report as well. We are concerned with two kinds of manipulations.

Collusion: S can collude with A by taking a bribe and misreporting $\theta = p$ as $\theta = n$; $m_s = n$. S and A can share the gain from such collusion.

Extortion: S can also take a bribe so as not to report $\theta = n$ as $\theta = p$; $m_s = p$.

Even though both these types of manipulation can affect the implementation of ΔF in a similar fashion and both involve bribery, they differ in at least two fundamental ways. Firstly, collusion is more of a cooperative venture and extortion is not. Extortion involves threat by S to misreport and this threat may not be credible. Secondly, collusion takes place in the state where the illegal act has been committed. So there are affected parties who have incurred some cost or damage and hence collusion between S and A always runs the risk of discovery. This has been capture in the literature in the form of transaction cost in collusion. A bribe of x paid by A to S is worth kx to S, k<1. Similar transaction cost need not be there in case of extortion. We want to see whether and how ΔF can be implemented.

A mechanism M will specify how reports will be made and how transfers will be made conditional on these reports. Let m_s, m_a denote the reports made by S and A respectively. Since both of them observe the state with certainty, we will not consider cases where they can report nothing. Hence $m_j \in \{n, p\}$, j = S, A. Let $t_j\ (m_s, m_a)$ denote the transfer specified by M. We can consider simultaneous or sequential reports by S and A.

Timing:

(i)The regulator announces the mechanism M.

(ii) Firms choose whether to pollute or not. A firm (A) is inspected with certain probability and the inspector (S) learns the true state θ.

(iii) The inspector (S) and the firm (A) can agree on side contract and play the mechanism M according to this contract. We can allow unlimited communication between them, but assume that the firm makes the bribe offer which the inspector can refuse or accept.

(iv) If no such side contract has been agreed in (iii), they play M non-cooperatively.

(v) All payoffs according to M are realised.

Revelation Principle: The revelation principle has been a cornerstone of mechanism design. Intuitively, if true states are being reported, it will also imply that there is no collusion taking place between S and A. However, truthful revelation does not exclude extortion.

Let k_p (k_n) denote the transaction cost associated with bribery in state θ = p (θ = n). As discussed earlier, $k_p < k_n$. Let ΔF = *f*. Then there is a mechanism M which can induce truthful revelation of information. We can have

$t_s(n,n) = t_a(n,n) = 0,\ t_s(p,n) = -g,$ (1)

$t_a(p,n) = -(f + \varepsilon)$, $t_s(p,p) = k_p f$ and $t_a(p,p) = -f.$

It can be seen that when $\theta = p$, there is no incentive for S and A to collude and $m_s = p$, $m_a = p$. However, when $\theta = n$, inspector S will have an incentive to report *p*. Since ε >0, A is better off reporting *p* as well. But A can then offer a bribe $x \leq f$ such that $k_n x > k_p f$. S will accept such an offer and report n. So in *either state the true state is being reported* but A has to pay a bribe *x* in state $\theta = n$ and pay a fine *f* in state $\theta = p$. Hence ΔF = $(f-x) < f$. Hence, in equilibrium we have truthful revelation but the agent has to pay a bribe to the supervisor.

Note that preventing collusion is only part of the problem. Suppose θ = p, and S makes a true report without colluding with A. We also want A to report the same, becasue A can otherwise report n. On the other hand when θ = n and S reports m = p, we want A to report n. This way extortion can be prevented. If extortion is not prevented, a fully revealing equilibrium might exist but it might fail to implement the desired ΔF. This suggests that we need mechanisms which are both collusion-proof and extortion-proof. We shall use the notion of strong implementation and consider cases where there is no equilibrium where collusion or extortion takes place.

This implies that the transfers $t_a(p,n)$ must take different values depending on the true state. Let $\theta = n$. S will make a true report if and only if $t_s(n,n) > t_s(p,n)$. Similarly, when $\theta = p$, we need $t_a(p,p) > t_a(p,n)$. In addition we also need the no collusion constraint to hold. Hence the transfers must satisfy the following

$k[t_a(n,n)-t_a(p,p)] < [\ t_s(p,p)-t_s(n,n)]$ (2)

Since extortion can take place only if the firm does not challenge the inspector's false report, we need $t_a(p,p) > t_a(p,n)$. When the actual state is *n* and the inspector reports it as state *p*, the agent must report the true state *n*. In that case, the supervisor realises $t_s(p,n)$ which is less than the payoff from truth telling $t_s(n,n)$. These two conditions can not be satisfied[9]. Hence it can be checked that using reports alone it is not possible to implement all possible ΔF.

Verification: Investigations and Appeals

The previous discussion shows that we need some verification. We shall consider two types of verification procedures.

The regulator can commit to verify the reports in certain states. In that case the mechanism will specify not only the transfer but also the probability with which verification will be undertaken following any pair of reports. Given that verification is costly and the regulator would like to minimise costs, verification will not be undertaken in all possible states. So we want to implement ΔF in the least cost way. Let $q(m_s, m_a)$ be the probability that verification is undertaken when the supervisor and the agent report m_s and m_a respectively. It is easy to check that either $q(n,n)> 0$ or $q(p,n) > 0$. Clearly the mechanism with $q(n,n) > 0$ will not be preferred since this involves costly verification in equilibrium. We shall focus only on such mechanisms. Moreover, we are constrained to choose transfers satisfying the limited liability constraint. In addition we also assume that post-verification transfers can not be entirely arbitrary. For example, suppose both report n and the true state is deemed to be n and the principal announces some transfer without any verification. On the other hand suppose following any pair of reports, verification is undertaken and the true state is found to be n. The agent has to be treated symmetrically in these two cases. Transfers to the agent can not be very different from the previous transfers where the agent was accepted as a non-pollutant. Lastly, verification is imperfect so that the true state is revealed with probability $\delta > ½$.

Consider the following mechanism $q((m_s,m_a),t(m_s,m_a))$ with

$$q(n,n) = q(p,p) = 0, q(p,n) = 1,$$

$$t_s(n,n)= t_a(n,n)=0,\ t_s(p,p)=kf_a,\ t_a(p,p)= -f_a\ , \qquad (3)$$

[9] We can of course consider weak inequalities and these two can be satisfied as an equality. Hence there is one equilibrium where neither collusion nor extortion takes place, but there are also other equilibria where this is not true.

$t_s(p,n;n)= -f_s$ and $t_a(p,n;p)=-f_x-\varepsilon$, $t_s(p,n;p)= kf_a$ and $t_a(p,n;n)=-f_y+\varepsilon$.

The last row refers to the transfers when verification is undertaken following a report of p and n by S and A respectively and the verified state is n or p. Clearly this above mechanism is both collusion and extortion proof.

Our second restriction on transfers imply that $f_y = 0$. In that case, the regulator can not set a high fine $t_a(p,p)$ because $t_a(p,p) < \delta\ t_a(p,n;p) \leqslant \delta W$. We can summarise this in the following proposition.

Proposition 1: There exist mechanisms such that neither collusion nor extortion occurs in equilibrium. No mechanism can implement $\Delta F > \Delta F_\delta$ where $\Delta F_\delta < W$ for $\delta < 1$.

This implies that it won't be possible to implement very high fines and in these cases, one will have to raise the monitoring probability μ..[10]

Alternatively, we can separate the problems of collusion and extortion. Instead of having a mechanism which prescribes verification, the mechanism can be supplemented by a system of 'appeals' where the agent can appeal. Appeals differ from investigations in two distinct characteristics. First, verification is no more a decision variable of the regulator and limited commitment on the part of the regulator will not affect the appeals process. Second, appeals will involve a cost for the agent. A successful appeal can lead to reimbursement of cost but as we shall see, it might still leave some costs for the agent to bear.

Consider a mechanism M with appeals of the following kind[11]. S submits its report m_s. If $m_s = n$, then the game ends and both get zero. If $m_s = p$, then A can either accept or appeal. If A accepts then S gets a transfer kf and A pays the fine f. However, if A appeals then it incurs a fixed cost C irrespective of the outcome. The appeal leads to the true state being upheld with probability δ. So if $\theta = n$, appeal is upheld with probability δ and if $\theta = p$, it is upheld with probability $1-\delta$. If the appeal is upheld, S pays T_s and A receives $T_a \leqslant T_s$. If the appeal is rejected, S receives kf and A pays the fine f.

For the mechanism to be extortion proof, we need that whenever $\theta = n$, A should appeal following a report of $m_s = p$. Then S would get $\delta(-T_s) + (1-\delta)kf$. S would always report

[10] In such cases, we might have mechanisms with $q(n,n)>0$.

[11] The extensive forms for different states are depicted in figure 1 and figure 2.

truthfully if $\delta(-T_s) + (1-\delta)kf < 0$ or, $T_s > (1-\delta)kf/\delta$. It is clear that A would choose to appeal if $\delta(T_a+f) \geqslant C$ or $T_a \geqslant C/\delta - f$. On the other hand, when $\theta = p$, we need A to accept whatever S reports. A would accept a report of $m_s = p$, if $C \geqslant (1-\delta)(T_a+f)$ or $T_a \leqslant C/1-\delta - f$. Both these are satisfied for any C and f if $\delta > 1/2$. In addition, this mechanism is also collusion proof. Whenever, $\theta = p$, the supervisor would report truthfully since no bribe smaller than f would induce him to collude with A. Hence this mechanism is both collusion and extortion proof. We summarise this in the following Proposition.

Proposition 2: There exists a mechanism M which is both collusion and extortion proof. It implements any desired ΔF.

The ability to implement any set of fines (ΔF) crucially depends on the regulator ability to choose transfers T_s, T_a. However, if the regulator can not choose transfers arbitrarily, the agent might incur a net positive cost in appeals. Suppose $T_a = \alpha C$ where α is some constant. In that case, if the we want to implement a large fine, α has to be small so that no appeal is made in sate $\theta = p$. But a small α would mean that, for some fines, the agent might not appeal as the fixed cost of appeal might outweigh the benefit. In that case one can still implement large fines but not small ones.

Corollary 3: When appeals involve a positive net cost, it may not be possible to implement $\Delta F \leqslant \Delta F_c$.

3. ENFORCEMENT AND MARGINAL DETRRENCE

We consider an extended version of the previous model of enforcement[12]. There are three types of firms denoted by X, Y and Z. Each firm chooses pollution level $a_n \in A$, where $A = \{ a_0, a_1, a_2 \}$[13] with the corresponding harm to the society being 0, h_1, and h_2. Let $b_j(a_n)$ denote the private benefit to type j firm (j = X,Y,Z) from action a_n (n = 01,2). We assume that they are as follows[14]:

X- 0, b_1, b_2

[12] This is a slightly modified and discrete version of Mookherjee and Png (94). They have studied marginal deterrence in absence of collusion or extortion.

[13] So a_0 can be interpreted as $\theta = n$ of the previous section. But there are two polluting (p) states.

[14] The exact specification is not crucial, we need some kind of sorting condition. Z derives more benefit than Y both in absolute and marginal sense. Similarly for, Y and X.

Y- 0,2 b_1,2 b_2 (6)

Z- 0,3 b_1,3 b_2

Firms are all risk neutral. Firm's type information is not available to the regulator. Hence the regulator can not condition monitoring intensity on the firm's type. Hence all firms are subject to same rate of monitoring. Fines differ across actions but not across firm types. Their utility from any act is given by $U_j = b_j\,(a_n) - \mu f_n$, j = X,Y,Z and n = 0,1,2 where μ is the probability of apprehension and f refers to the fine for the particular act.

We assume that $3b_2\text{-}h_2 > 3b_1\text{-}\ h_1 > 2b_1\text{-}h_1 > 0 > 2b_2\text{-}h_2 > b_1\text{-}h_1 > b_2\text{-}h_2$ (7)

Social welfare is given by

$$SW= \sum_j b_j(a_n^j) - h_n - C(\mu)\,. \tag{8}$$

It is clear that when the cost of enforcement is zero, the first best action profile for X,Y and Z would be given by

$$a^X = a_0\,,\ a^Y = a_1 \text{ and } a^Z = a_2 \tag{9}$$

For much of the analysis we shall assume that $C(\mu) = c_m\,\mu$, where the cost of monitoring is $c_m\mu$ per firm. The regulator would choose an action profile to be implemented by a policy/mechanism $\{\mu,\ f_0,f_1,f_2\}$. Firm's identical wealth is given by w. Hence we assume that $f_n \le w$ for all n. Note that the regulator may not always implement the fist best schedule. In particular we shall consider two kinds of cases. We shall refer to action schedules $\{a_0,a_0,a_2\}$ and $\{a_1,a_1,a_2\}$ as over enforcement and under enforcement. In the first case even though a firm's benefit from an action exceeds the social cost associated with it, the firm is prevented from choosing the particular action. In the second case, a firm might be allowed to chose an action even if the harm exceeds the private benefit. In our particular case of $\{a_1,a_1,a_2\}$, the regulator has effectively legalized action a_1. It is not trying to deter anyone from choosing a_1.

Enforcement in the Absence of Collusion or Extortion:

Clearly, $f_0 = 0$ and $f_2 = w$. The optimal pattern of behaviour would be one of the possibilities shown in Table 1. If the monitoring cost c_m is not too high, then optimal choice would be to implement (0, a_1, a_2) and social welfare is given by $S = 3b_2\text{-}h_2\text{+ }2b_1\text{-}h_1 - (2b_2\text{-}b_1)c_m/w$. This is highest if $(h_2\text{-}h_1) - 2(b_2\text{-}b_1) - (b_2\text{-}b_1)c_m/w > 0$ and $h_1 - b_1 - b_1c_m/w > 0$. Notice that over-enforcement (0,0,a_2) is never optimal. If (0,0,a_2) can be implemented, so can be (0, a_1, a_2); the latter outcome has lower monitoring cost and greater benefits.

It can also be seen from the Table that the optimal enforcement policy might change as cost of monitoring goes up. There exists a c^0 such that for all $c_m > c^0$, the optimal policy would be to legalise a_1 and implement (a_1,a_1,a_2) [15]. Certain harmful activities may be legalised not because their private benefit exceed the social costs, but because legalisation of these activities makes it easier to achieve deterrence from more harmful activities. In the present example we can also have (0, a_2,a_2) as an optimal policy[16]. This differs from the previous case in the sense that there is under-enforcement but it is at the top end. No act has been legalized but now the Y types are not being prevented from the more harmful act a_2.

We can summarise this benchmark case in the following Proposition

Proposition 4:

(i) For sufficiently large W or small C_m, {a_0,a_1 ,a_2} is always the optimal enforcement policy.

(ii) Over enforcement is <u>never</u> optimal.

(iii) For larger values of C_m, under-enforcement {a_1,a_1 ,a_2} legalisation of the less harmful act is optimal

Proof: The details are given in the appendix.

4. OPTIMAL POLICY UNDER COLLUSION AND EXTORTION

Suppose the inspector is corruptible and can under report. Hence mechanisms discussed in Section 2 which seek to elicit the true information would come into picture. Recall that in our framework, the firm proposes a bribe in the side contract stage. We shall continue with this assumption. Most of the qualitative results won't be affected by this.

Let F_n be the expected total cost to the firm from act a_n. This would include fine and possible bribe payment. If the firm colludes with the inspector and a_n is reported as a_m, m <n and the firm pays a bribe z, then $F_n = \mu(f_m + b)$. An action a_n is collusion proof,

[15] This is so if h_1-b_1 < b_1C_m/w.

[16] This is likely to happen when the difference between the harms is not very large; (h_2-h_1) < 2(b_2-b_1) +(b_2-b_1)c_m/w.

if the firm and the inspector can not collude to under report n as m. Similarly, a_n is extortion proof if a_n can not be reported as a_m, m > n. A mechanism M is collusion proof (extortion proof) if all the actions are collusion proof (extortion proof). Let c be the net cost of choosing appeal. For the remainder of the section we take $k_p = k$ and $k_n = 1$. Hence bribery under collusion involves transaction cost.

Collusion

It is clear that collusion alone does not affect the optimal policy. This is because collusion can be prevented without adding to the enforcement cost. Recall that transfers do not enter our social welfare function. This is true of public enforcement situations but transfers will matter in private enforcement situations. In that case there the regulator might have to take into account the cost of preventing collusion.

Proposition 5 : Let **a** be the optimal schedule of actions when there is no collusion possibilities. Then, it is also optimal even when there is collusion possibility.

Proof: If the mechanism induces collusion, then cost of enforcement is always higher and in some cases no deterrence can be achieved. However, collusion proof mechanisms exist and the optimal action schedule **a** can be enforced using such a mechanism. Since rewards and fines do not enter our social welfare function, the inspector gets kf_n for reporting action a_n. This means that they do not gain anything by colluding and hence always report the truth. So $F_n = \mu f_n$.

Extortion

As discussed earlier, possibility of over reporting also affects the firm's choice of action by affecting F_n. A firm choosing say a_1 will not only have to face a fine f_l but might have to pay an extortion bribe $k(f_2\text{-}f_l)$. The inspector gets kf_2 by reporting the firm as a_2 and the firm accepts and does not appeal. On the other hand, the inspector gets kf_l by reporting a_1. Hence the firm will offer a bribe of $k(f_2\text{-}f_l)$ to avoid being over reported. This is possible if the firm is not going appeal following the inspector's report a_2. As we saw in the previous section, the firm will not appeal if the net appeal costs are high compared to the fines.

Before we discuss the mechanism with appeals let us see how extortion will affect the incentives of the firms. From the table it is clear that (a_0,a_1,a_2) can be implemented by setting $\mu = (2b_2\text{-}b_1)/w$, $f_0 = 0$, $f_l = b_1w/(2b_2\text{-}b_1)$, $f_2 = w$ and $r_n = kf_n$. It can be checked that this policy will not implement (a_0,a_1,a_2) if firms can be over reported. Note that all firms can be simply reported as a_2. In that case the a_0-type firm will have to pay a bribe of kf_2. The a_1- type firm will pay a fine of f_1 and a bribe of $k(f_2-f_1)$. The a_2-type firm can not be over-reported and hence pays a fine f_2. Can (a_0,a_1,a_2) be implemented now? Even though one would expect that enforcement has become severely distorted now, it is still possible to implement (a_0,a_1,a_2) in some cases.

Note that we need,

$-F_0 \geq b_1- F_1$ and $-F_0 \geq b_2- F_2$ (10)

$-F_0 \leq 2b_1- F_1$, $2b_1 -F_1 \geq 2b_2- F_2$ (11)

$-F_0 \leq 3b_2- F_2$, $3b_1 -F_1 \leq 3b_2- F_2$ (12)

Using the fact that $F_0 = \mu kf_2$, $F_1 = \mu(kf_2+(1-k)f_1)$ and $F_2 = \mu f_2$, it can be checked that (a_0,a_1,a_2) be implemented if the following pairs of inequalities are satisfied.

$3(b_2-b_1) \geq \mu (1-k)(f_2-f_1) \geq 2 (b_2-b_1)$

$2b_1\geq \mu(1-k)f_1 \geq b_1$

$3b_2 \geq \mu(1-k)f_2 \geq b_2$

Example 1: Let $b_1= 8$, $b_2 = 15$, $W = 44$ $k = ½$. It can be checked that for $f_0=0$, $f_1 = 16$, $f_2 = 22$ and $\mu = 1$, we can satisfy all the above conditions and (a_0,a_1,a_2) can be implemented. However, as one would expect, μ has to be higher.

With extortion possibilities, (a_0,a_1,a_2) may be implemented in some cases but cost of enforcement can never be lower than the case without extortion. The above example shows that (a_0,a_1,a_2) can be implemented with extortion. Let the optimal mechanism be (μ, f_0,f_1,f_2). When there is no extortion, the regulator can always choose the same monitoring intensity with (μ, f'_0, f_1', f'_2) such that $f'_0 = kf_2$, $f'_1 = kf_2+(1-k)f_1$ and $f'_2 = f_2$. This would suggest that one could do better by considering extortion proof mechanisms. Following the results of the previous section, we consider mechanisms where the firm can appeal following the report by the inspector. We simplify the analysis by restricting attention to simple appeals process where the true state (action a_n) is revealed with certainty following an appeal and the firm bears some cost c. Suppose the true state is a_n and it is reported as a_m, $m >n$. This would mean that a firm would appeal if $c<f_m-f_n$. If the

firm is going to appeal, the inspector is never going to misreport. This mechanism would give the same results as the mechanism in Proposition 2 and Corollary 3, whenever the transfers T_a are bounded above due to some constraints.

We also assume that c < w, so that there is some scope for the mechanism to be extortion proof. This also means that a_0-type firm may not appeal if reported as a_1, but it would appeal if reported as a_2. This would further constrain the regulator over the choice of $\{f_n\}$. A mechanism is extortion proof if all the actions are extortion proof. However we might have mechanisms where only a_1 (a_0) is extortion proof but not a_0 (a_1).

The value of the appeals process can be seen in the following claim. Consider the action schedule (a_0,a_1,a_2). If it can be implemented by an extortion proof mechanism, then no other mechanism can implement (a_0,a_1,a_2) with lower cost. However, (a_0,a_1,a_2) can not be implemented in some cases. The following proposition shows that this is the case.

Proposition 6: The first best outcome (a_0, a_1, a_2) can not be implemented by any mechanism even when wealth w is large enough to enforce complete deterrence, when the judicial cost *c* lies in the interval [c* c**]. In such cases it might be optimal to have over-enforcement.

Proof: We shall show that such an interval exists. Let the interval be given by the following

$$c^* = \frac{3(b_2 - b_1)w}{3b_2 - b_1}, c^{**} = 4(b_2 - b_1)$$ [17].

Suppose there exists mechanism implementing (a_0,a_1,a_2) such that no act is extortion proof. So a_0 will be reported as a_1 and $a_1$can be reported as a_2. However, in equilibrium true reports will be obtained but the firm would have paid bribes to the inspector to report the truth. Hence the expected payments for the different acts are given by

$F_0 = \mu k f_1$, $F_1 = \mu(kf_2+(1-k)f_1)$ and $F_2 = \mu f_2$.

Now to ensure that Y chooses a_1 and not a_2, we need

$$\mu (1-k)(f_2-f_1) \geq 2 (b_2-b_1) \quad (13)$$

[17] Assume k = ½, for illustration purpose only. In addition, b_2 is assumed to be large compared to b_1 such that $12b_2-4b_1-w > 0$. This ensures that such a condition can be satisfied. Otherwise the interval might be empty.

With extortion threats, to implement $(0, a_1, a_2)$, f_1 has to be brought down and that makes $(f_2\text{-}f_1)$ large. Note that inequality (13) implies that $(f_2 - f_1) \geq 2\ (b_2\text{-}b_1)/(1\text{-}k)$. That means, $(f_2 - f_1) > c$. Hence, act a_1 is now extortion proof and such a mechanism does not exist.

Next, suppose, (a_0, a_1, a_2) can be implemented using a mechanism such that act a_1 is extortion proof. Then the expected fines are given by

$F_0 = \mu k f_1$, $F_1 = \mu(f_1)$ and $F_2 = \mu f_2$.

To ensure that Z will choose a_2 and not a_1, we need

$$3(b_2\text{-}b_1) \geq \mu(f_2\text{-}f_1) \tag{14}$$

Similarly to ensure that X chooses a_0 over a_1, we need

$$b_1/(1\text{-}k) \leq \mu f_1 \tag{15}$$

Since a_0 is not extortion proof but a_1 is, we can not make f_1 very small. Suppose we want to maximize $(f_2\text{-}f_1)$ subject to these two constraints. It is clear that $(f_2\text{-}f_1)$ will be maximized when $f_2 = w$ and $b_1 = (1\text{-}k)\mu f_1$. Using this and $k = ½$, we get

$$f_1 \geq \frac{2b_1 w}{3b_2 - b_1}$$

$$\text{or, } (f_2\text{-}f_1) \leq \frac{3(b_2 - b_1)w}{3b_2 - b_1} \tag{16}$$

But this implies that $(f_2\text{-}f_1) < c$ and hence act a_1 can not be extortion proof.

Now suppose, $(0,a_1,a_2)$ can not be implemented by (μ,f_1,f_2) such that a_0 is extortion proof and a_1 is not. Then the incentive constraint of firm Y will be

$$2b_2\text{-}\ \mu f_2 \leq 2b_1\text{-}\ \mu(f_1+f_2)/2$$

$$\text{Or, } \mu(f_2\text{-}f_1) \geq 4\ (b_2\text{-}b_1) \tag{18}$$

But (18) is exactly same as (14) and hence given the values of c we have a contradiction that a_1 is not extortion proof.

Lastly, is it possible to implement the first best so that all the acts are extortion proof? Given that b_2 is large compared to b_1, this is also not possible. Notice that to have no extortion at all we need $f_2 > 2C$ and given the lower bound on c in the proposition this implies[18] $3b_2 < 5b_1$.

It may not be possible to implement the first best outcome even without extortion possibilities, if w is quite low. But that is not the case here. In fact w may be large enough so that more deterrence than the first best can be achieved. If $w > 2b_2$, then we can implement a policy of over enforcement (a_0,a_0,a_2). This can be achieved by setting $f_1 = f_2 = w$ and $\mu = 2b_2/w$. This would never have been optimal when (a_0,a_1,a_2) could be implemented, but now over-enforcement can be an optimal policy for certain values of c_m, h_1 and h_2.

Example 2: Let $b_1 = 8$, $b_2 = 15$, $w = 40$, $h_2 = 35$, $h_1 = 15$ and $c = 24$. Clearly these values satisfy condition (A1). Note that c also belong to the interval mentioned in the proposition, $c \in (22 \quad 28)$. It can be checked that (a_0,a_1,a_2) can not be implemented. However, (a_0,a_0,a_2) can be implemented by setting $\mu = 3/4$, $f_1 = f_2 = 40$. Now for monitoring cost $c_m < 12$, the policy of over-enforcement dominates all other policies. []

The above proposition does not claim that first best can be implemented when c lies outside the interval. Depending on the values of b_1 and b_2, it may be impossible to implement the first best even if c lies outside the interval.

Similarly, the optimality of the policy of over-enforcement does not depend on the inability to implement the first best. We shall show that over-enforcement can be optimal even when it is possible to implement the first best action schedule.

We now turn attention to situations where the first best can be implemented. However, this need not be the optimal policy if monitoring cost is high. As mentioned earlier, the optimal policy in such situations might involve legalization of some of the less harmful acts (a_1 in this case). Does the presence of extortion make a difference to this result? Note that when c is low the least cost implementation of the first best involves no extortion. Since $c < w$, the implementation of (a_1,a_1,a_2) also involves no extortion. Hence for very small values of c, the presence of extortion possibilities does not make a difference to the legalization issue.

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[18] In this case $f_2 = w$, hence $w > 6(b_2-b_1)w/(3b_2-b_1)$ or, $5b_1 > 3b_2$.

Proposition 7:

(a) Legalization of the less harmful act a_0 is more likely to be an optimal policy in the presence of extortion possibilities.

(b) A mechanism with partial extortion proof-ness may not be better than another mechanism with no extortion proof-ness.

(c) Over-enforcement (a_0,a_0,a_2) may be optimal even when it is possible to implement the first best (a_0,a_1,a_2).

Proof: Details are given in the Appendix. Part (a) is easy to see. Under enforcement turn out to be the optimal policy even without corruption because of the enforcement cost μc_m. Since with corruption, μ is going to be higher, it is possible that under enforcement is optimal for a greater range of values of c_m given benefits and costs. Part (b) shows that it is not possible to rank mechanisms according to the degree of extortion. We saw in Proposition 6 that over enforcement can be optimal when it is not possible to implement the first best. Part (c) shows that over enforcement can be optimal even when first best action schedule could be implemented.

5. CONCLUSION

We have shown that optimal enforcement policy is affected by the presence of collusion and extortion. In particular, we are more likely to see under or over enforcement as optimal policy responses in such situations. The possibility of under enforcement has been noted in the literature[19], but the paper shows that over enforcement can also be optimal.

We have also shown that extortion possibilities complicate the mechanism design problem under collusion. Measures to control collusion are likely to encourage extortion[20]. It is possible to design mechanism which would prevent both collusion and extortion. But these mechanisms would require extensive set of transfers. In many cases, this requires separate institutions. For example, even though the regulator designs the monitoring intensity, the fines and the rewards, appeals are judged by outside institutions

[19] See Mookherjee and Png (1994). They also report over enforcement but for different reasons.

[20] This conflict has been noted by Polinsky and Shavell (2000), but they don't consider the full range of mechanism design.

(courts). The regulator may not have much control over the planned transfers following such an appeal.

Moreover, in our model, there is no appeal in equilibrium. This follows from the restrictive set up. There is no scope for frivolous appeals. It is possible to extend the model to capture the appeals process more appropriately.

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APPENDIX

Proof of Proposition 4 :

The optimal pattern of behaviour can be derived as follows. The Table below gives the least cost policy (μ, f_0,f_1) and social welfare SW associated with different action schedules[21]. The three rows refer to the first best, under enforcement and over enforcement respectively. Note that to implement (a_0,a_1,a_2) we need the policy to satisfy the following.

For X to choose a_0, we need

$-\mu f_0 \geq b_1-\mu f_1$ and $-\mu f_0 \geq b_2-\mu f_2$

For Y to choose a_1 we need,

$2b_1-\mu f_1 \geq -\mu f_0$, $2b_1-\mu f_1 \geq 2b_2-\mu f_2$

Likewise, for Z to choose a_2, we need

$3b_2-\mu f_2 \geq -\mu f_0$, $3b_2-\mu f_2 \geq 3b_1-\mu f_1$

Combining these inequalities we have,

$3b_2 \geq \mu (f_2-f_0) \geq b_2$

$3(b_2-b_1) \geq \mu (f_2-f_1) \geq 2(b_2-b_1)$

$2b_1 \geq \mu(f_1-f_0) \geq b_1$

We want to minimise μ subject to these constraints. It is clear that $f_0 = 0$ and $f_2 = w$. We can have either the right hand side of () or () as binding. Hence $\mu f_1 = b_1$. Using it in () we

[21] We have not considered many other possible combinations of actions for reasons of brevity. These can be obtained from the author.

get $\mu = (2b_2-b_1)/w$. Since $b_2 > b_1$, this also implies that $2b_2-b_1 > b_2$. On the other hand if $\mu f_2 = b_2$, the last inequality will not be satisfied. Hence $\mu = (2b_2-b_1)/w$ is the lowest monitoring intensity. The other numbers in the table follows.

Similarly, we can find the minimum μ for other schedule of actions.

Table 1

Behaviour			μ	Fines			Welfare
X	Y	Z		f_0	f_1	f_2	
0	a_1	a_2	$(2b_2-b_1)/w$	0	$b_1w/(2b_2-b_1)$	w	$3b_2-h_2+2b_1-h_1-(2b_2-b_1)C_m/w$.
a_1	a_1	a_2	$2(b_2-b_1)/w$	0	0	w	$3b_2-h_2+2b_1-h_1+(b_1-h_1)-2(b_2-b_1)C_m/w$.
a_0	a_0	a_2	$2b_2/W$	0	W	W	$3b_2-h_2+ -(2b_2)C_m/w$.

Proof of Proposition 7

(a) When there is no extortion possibility, (a_1,a_1,a_2) can be optimal if c_m is not very low. Since judicial cost c <w, (a_1,a_1,a_2) can always be implemented by an extortion proof mechanism. Hence it is optimal also. In addition, implementing (a_0,a_1,a_2) in the presence of extortion implies a higher μ, it is likely that higher monitoring cost would outweigh the benefit of implementing (a_0,a_1,a_2) and (a_1,a_1,a_2) would be optimal.

(b) Let $b_1 = 6$, $b_2 = 7$, $W = 30$, $C = 21$. Suppose we wish to implement policy $\mathbf{(a_0,a_1,a_2)}$. It can be implemented by a mechanism where neither a_0 nor a_1 is extortion-proof. It can be verified that $\{\mu = 2/5, f_1 = 20 \text{ and } f_2 = 30\}$ will implement this policy. To see this, the expected total fine for $a_0 = (10)2/5 = 4$. The total expected fine for act $a_1 = (20 + 10/2)\,2/5 = 10$ and the expected fine for $a_2 = (30)2/5 = 12$. Given this X will choose a_0 since $-4 \geqslant 6-10 > 7-12$. Similarly, Y will choose a_1, since $12-10 \geqslant 14-12 > -4$. Lastly, Z will choose a_2 because $21-12 > 18-10 > -4$.

On the other hand we can also implement $\mathbf{(a_0,a_1,a_2)}$ by another mechanism where a_0 is extortion proof. The optimal mechanism will be $\{\mu = 4/9, f_1= 21, f_2= 30\}$.It can be checked that μ can not be lowered. Now the total expected fines for the three acts are

$F(a_0) = 0$, $F(a_1) = (21+9/2)4/9 = 102/9$ and $F(a_2) = 120/9$. Hence X will prefer act a_0. Y will choose a_1 since $12-102/9 \geqslant 14-120/9 > 0$ and Z will choose a_2.

Hence to implement **(a_0,a_1,a_2)**, mechanism {$\mu = 2/5$, $f_1 = 20$ and $f_2 = 30$} is better than {$\mu = 4/9$, $f_1= 21$, $f_2= 30$} as the latter involves higher monitoring cost. But the second mechanism has less extortion. The opposite result will be obtained if C =16. Now {$\mu = 2/5$, $f_1 = 15$ and $f_2 = 30$} can implement the policy at the same cost, but the least cost a_0-extortion proof mechanism is {$\mu = 2/7$, $f_1 = 16$ and $f_2 = 30$}.

(c) Let $b_1= 6$, $b_2= 11$ W = 33 and C = 18. For these parameter values, enforcing (a_0,a_1,a_2) would mean choosing an a_1-extortion free outcome with the following fines and monitoring intensity.

$f_1 = 15$, $f_2 = 33$ and $\mu = 4/5$

It can be verified that we can not have any other outcome implementing (a_0,a_1,a_2) with a lower μ.

At the same time one can have a policy of over enforcement (a_0,a_0,a_2) with $f_1= f_2= 33$ and $\mu = 2/3$. Hence the over enforcement policy leads to a cost savings of $(2/15)C_m$. There is however a welfare loss of $(2b_1-h_1)$ in over enforcement. Hence over enforcement is better than the policy if implementing the first best iff

$$(2/15)C_m > 12-h_1.$$

But is it also better than under enforcement? Once can implement (a_1,a_1,a_2) with $f_1= 0$, $f_2= 33$ and $\mu = 10/33$. Comparing this with the policy of over enforcement, the latter is better iff

$$h_1 – b_1 < 2b_1-h_1 + (2/33)C_m$$

Let $h_1 = 10$ and $C_m = 16$. Clearly both the inequalities are satisfied. It can be checked that this is true for a range of values and not just these two.

However, it remains to be shown that the policy (a_0,a_1,a_2) was indeed optimal when there is no extortion possibility. From table 1 it can be checked that

$$W_{FB} = (33-h_2) + (12-h_1) – (16/33)C_m$$

$$W_O = (33-h_2) - (22/33)C_m$$

$$W_U = (33-h_2) + (12-h_1) - (h_1-b_1) - (10/33)C_m$$

Clearly, $W_{FB} > W_O$. In addition, $W_{FB} > W_U$ for the values of $C_m = 16$ and $h_1 = 10$. Hence even though it is optimal to implement (a_0,a_1,a_2) in the absence of extortion possibilities, it may be optimal to have a policy of over enforcement when there is extortion.[]

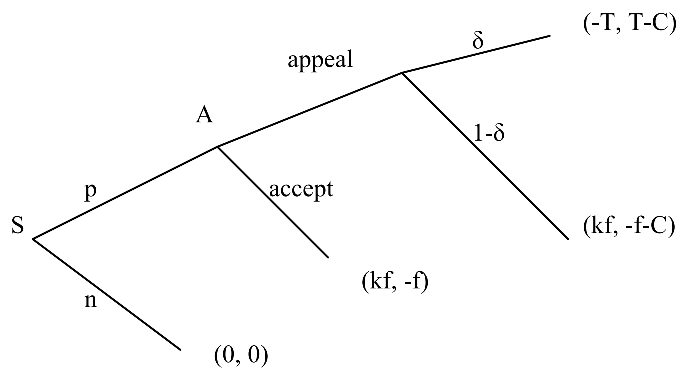

Fig 1, **θ = n**

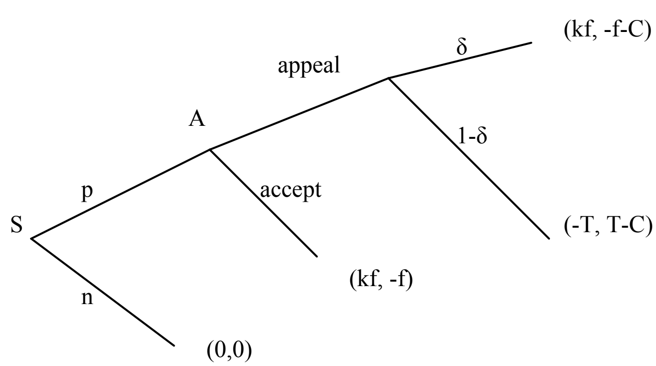

Fig 2**, θ = p**